
CHAPTER 6

CONCLUSIONS/RECOMMENDATIONS

6.1 SUMMARY

The following summary presents the major points made in each chapter of this guidance.

Hazard Identification

- For the dermal-water pathway, only those chemicals which contribute to more than 10% of the dose from the oral (drinking water) pathway should be considered important enough to carry through the risk assessment.
- For the dermal-soil pathway, the limited availability of dermal absorption values is expected to result in a limited number of inorganic contaminants being considered in a quantitative risk assessment. An important decision for the risk assessor is whether the default value of 10% dermal absorption from soil, for all organic compounds without specific absorption values, should be applied to a quantitative risk assessment.

Exposure Assessment

- Since the K_p parameter has been identified as one of the major parameters contributing to uncertainty in the assessment of dermal exposures to contaminants in aqueous media, it is important that risk assessments be consistent when estimating this parameter. Since the variability between the predicted and measured K_p values is no greater than the variability in inter-laboratory replicated measurements, this guidance recommends the use of predicted K_p values (Appendices A and B) based on the equations in Chapter 3. However, there are some chemicals (Exhibit A-1) that fall outside the Effective Prediction Domain for determining K_p , particularly those with a high molecular weight and high K_{ow} values. To address these chemicals, a fraction absorbed (FA) term should be applied to account for the loss of chemical due to the desquamation of the outer skin layer and a corresponding reduction in the absorbed dermal dose. For halogenated chemicals,

Equation 3.8 could underestimate K_p due to the lower ratio of molar volume related to molecular weight for these halogenated compounds as compared to those included in the Flynn database. A new K_p correlation based on molar volume and $\log K_{ow}$ will be explored.

- This guidance presents recommended default exposure values for all variables for the dermal-water and dermal-soil pathways in Exhibits 3-2 and 3-5, respectively.
- For dermal-water exposures, the entire skin surface area is assumed to be available for exposure when bathing and swimming occurs. The assessor should note that a wading scenario may result in less surface area exposed. For dermal-soil exposures, clothing is expected to limit the extent of exposed surface area. For the adult resident, the total default surface area should include the head, hands, forearms and lower legs. For a residential child the default surface area should include the head, hands, forearms, lower legs and feet. For an adult commercial/industrial worker, the total default surface area should include the head, hands and forearms.
- During typical exposure scenarios, more soil is dermally contacted than is ingested. The default soil adherence factor (AF) for RME adult residential activities (0.07 mg/cm^2) should be based on the central tendency value for a high-end soil contact activity (e.g., a gardener). The default AF value for a RME child resident (0.2 mg/cm^2) should be based on both the high end estimate for an average soil contact activity (i.e., children playing in dry soil) and the central tendency AF estimates for a high-end soil contact-intensive activity (i.e., children playing in wet soil). The default AF value for a commercial/ industrial adult worker (0.2 mg/cm^2) should be based on the central tendency estimate for a high-end soil contact activity (i.e., utility worker).
- The contribution of dermal absorption of chemicals

from soils to the systemic dose generally is estimated to be more significant than direct ingestion for those chemicals which have a soil absorption fraction exceeding about 10%.

- Dermal-soil absorption values for ten compounds are provided in this guidance. Screening absorption values are provided for semi-volatile organic compounds as a class. No screening values are provided for inorganic compounds, due to the lack of sufficient data on which to base an appropriate default screening level for inorganics other than arsenic and cadmium. As new information on dermal absorption from soil becomes available, this guidance will be updated.

Toxicity Assessment

- Before estimating risk from dermal exposures, the toxicity factor should be adjusted so that it is based on an absorbed dose. Usually, adjustments of the toxicity factor are only necessary when the GI absorption of a chemical from a medium similar to the one employed in the critical study is significantly less than 100% (i.e., 50%). Recommended GI absorption values are presented in Exhibit 4-1.

6.2 EXPOSURES NOT INCLUDED IN CURRENT DERMAL GUIDANCE

- This guidance does not explicitly recommend exposure parameters for contact with contaminated sediment. This exclusion is due to the high degree of variability in sediment adherence and duration of sediment contact with the skin. However, information is included in the guidance document that would allow a risk assessor to assess sediment exposure on a site-specific basis.
- This guidance does not specifically address dermal toxicity, either acute or chronic. The dermal dose derived with this methodology provides an estimate of the contribution of the dermal pathway to the systemic dose. The exclusion of dermal toxicity should be considered an uncertainty issue that could underestimate the total risk.
- Current studies suggest that dermal exposure may be expected to contribute no more than 10% to the

total body burden of those chemicals present in the vapor phase. Therefore, this guidance does not include a method for assessing dermal absorption of chemicals in the vapor phase, with the assumption that inhalation will be the major exposure route for vapors. An exception may be workers wearing respiratory protection but not chemical protective clothing.

- The methodology described in this guidance does not cover the exposure associated with dermal contact with contaminated surfaces.

6.3 RECOMMENDATIONS

- The dermal risk guidance uses a mathematical model to predict absorption and risk from exposures to water. Contaminants for which there are sufficient data to predict dermal absorption with acceptable confidence are said to be within the model's effective predictive domain (EPD). Although the methodology can be used to predict dermal exposures and risk to contaminants in water outside the EPD, there appears to be greater uncertainty for these contaminants. OSWER and the workgroup, which developed this guidance, do not recommend that the model be used to quantify exposure and risk to contaminants in water that are outside the EPD in the "body" of the risk assessment. Rather, it is recommended that such information be presented in the discussion of uncertainty in the risk assessment. OSWER and the workgroup recommend that experimental studies to generate data for these chemicals be planned and completed during remedial investigations on Superfund sites where dermal exposures to these chemicals may occur, using site-specific exposure conditions as appropriate.
- OSWER and the dermal workgroup also encourage experiments to generate additional data on the soil dermal absorption fraction (see Appendix E). The dermal workgroup will work with regional risk assessors on the development of the study designs and will review study results submitted to it. Additional details, recommendations, and a few references are provided in Appendix E.
- The Superfund Dermal Workgroup will be available for consultation on dermal risk assessment

issues. It is recommended that the Workgroup be consulted before dermal absorption values other than those listed in Exhibit 3-4 or in Appendix B are used in quantitative risk assessments. In the future, risk assessors are encouraged to provide the Workgroup with new information regarding chemical-specific studies of dermal absorption from soil, or water, as well as any other exposure factors for the dermal pathway.

- Areas where additional research would provide much needed information for addressing the dermal exposure pathway include: 1) quantification of dermal absorption from soil (percent absorbed) for high priority compounds, including inorganic compounds, using both in vivo and in vitro techniques, 2) determination of the effect of soil type/size on bioavailability of soil-bound compounds, and 3) methods for assessing risks associated with direct dermal toxicity of chemical exposures.

- A Peer Consultation Workshop on Issues Associated with Dermal Exposure and Uptake was held December 10-11, 1998. The Workshop was sponsored by the EPA Risk Assessment Forum. A report summarizing the proceedings and recommendations of the Workshop can be obtained from the Risk Assessment Forum Web site (<http://www.epa.gov/ncea/raf/rafrpts.htm>).

Many of the Workshop recommendations for immediate action were incorporated into this guidance document. EPA is considering the development of a dermal database to be located on the EPA Web site that would provide information on chemico-physical properties, soil absorption and permeability coefficients of specific chemicals and information on dermal exposure parameters. Additional long-term recommendations, particularly the development of a unified model for assessing dermal exposure from multiple media (e.g., water and soil), will be considered for future research initiatives.